

Recent Tracking Results for FFAGs

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Acknowledgements

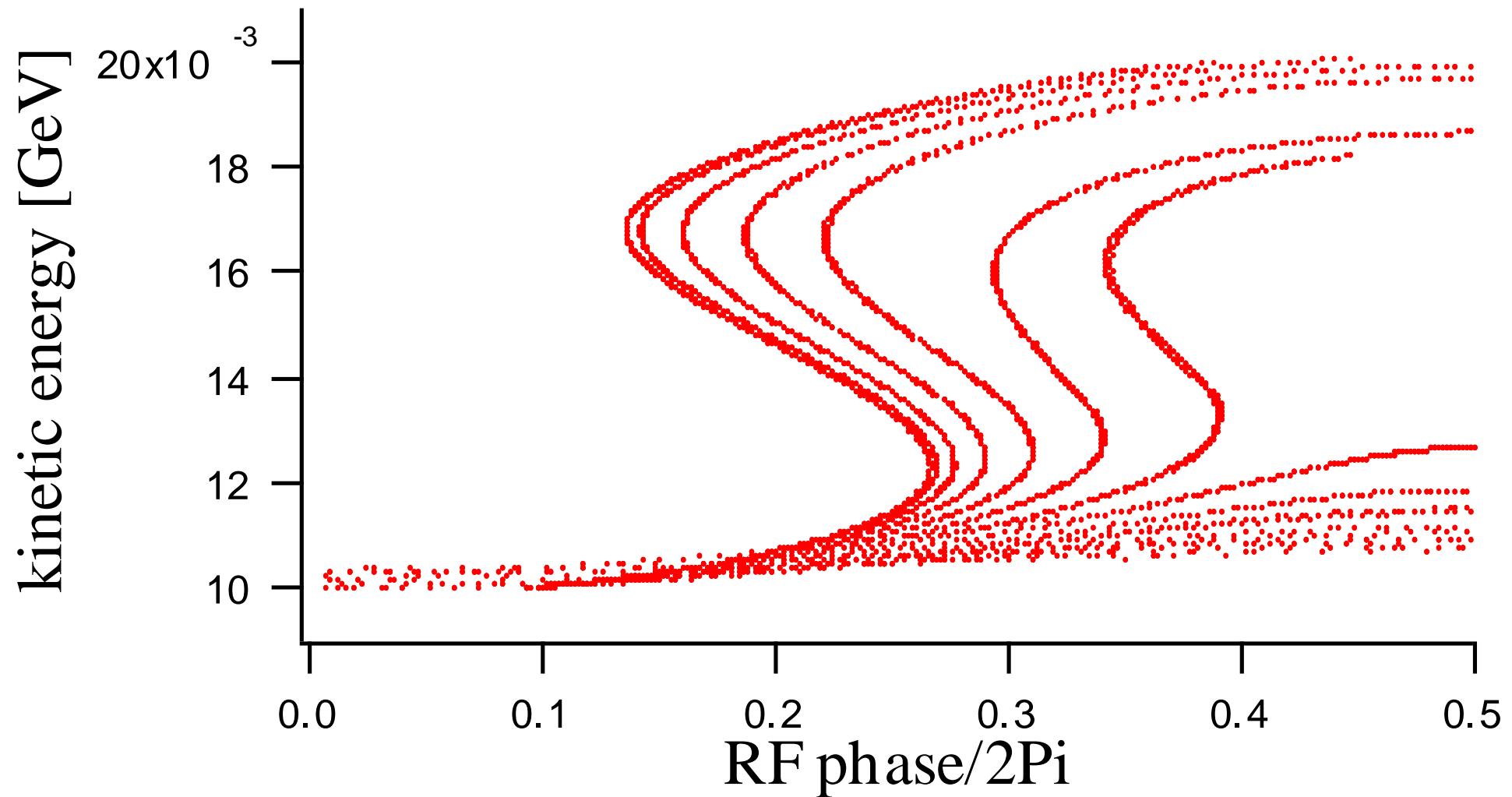
- Much of the tracking results come from other folks:
 - ◆ S. Machida (RAL)
 - ◆ F. Méot (CEA DAPNIA)
 - ◆ F. Lemuet (CEA DAPNIA, CERN)

Longitudinal Behavior Depends on Transverse Amplitude

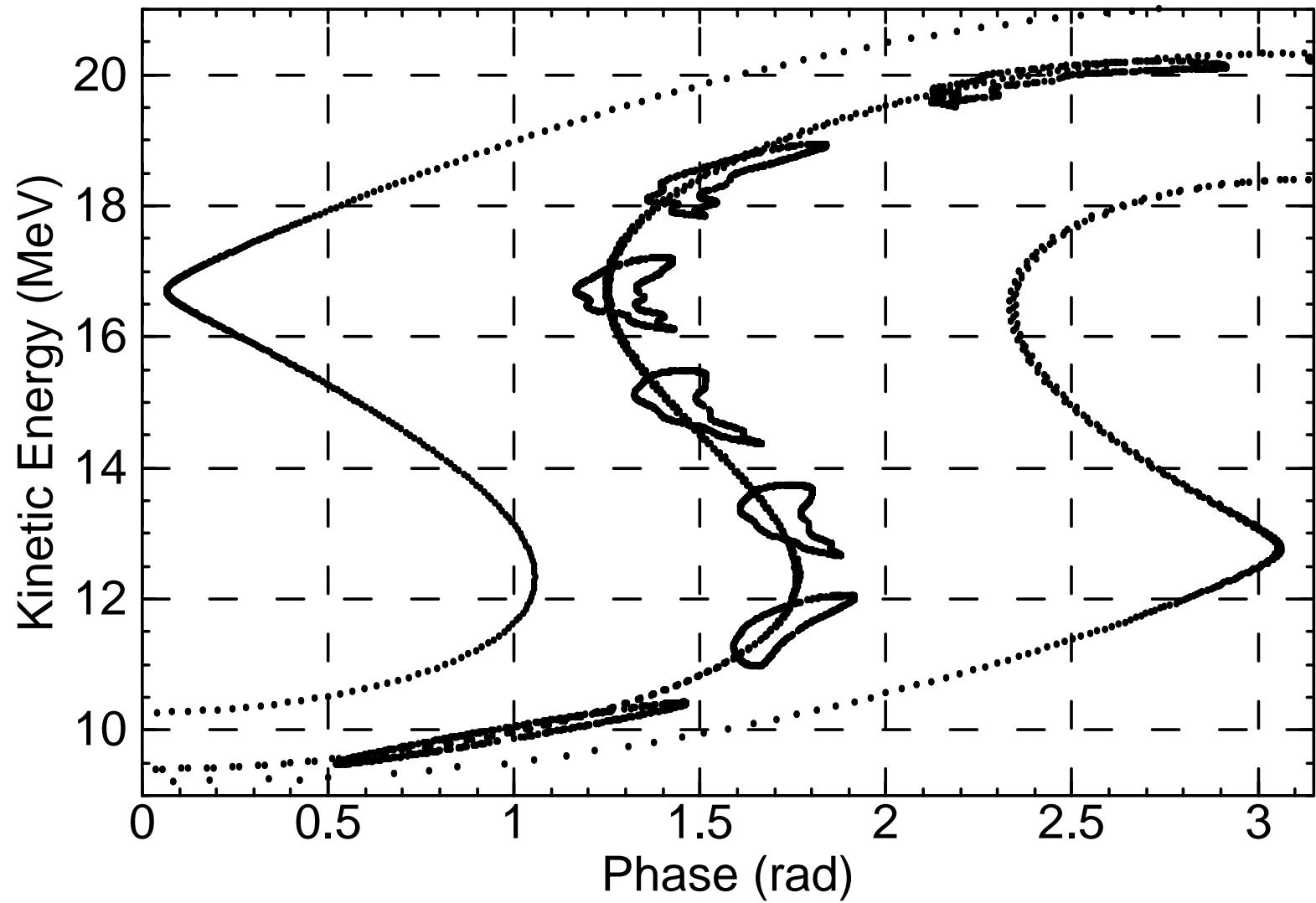
- Launch particles with larger enough transverse amplitude, some won't be accelerated
- For more moderate transverse amplitudes, get longitudinal emittance blowup

Single Particle in Longitudinal Phase Space

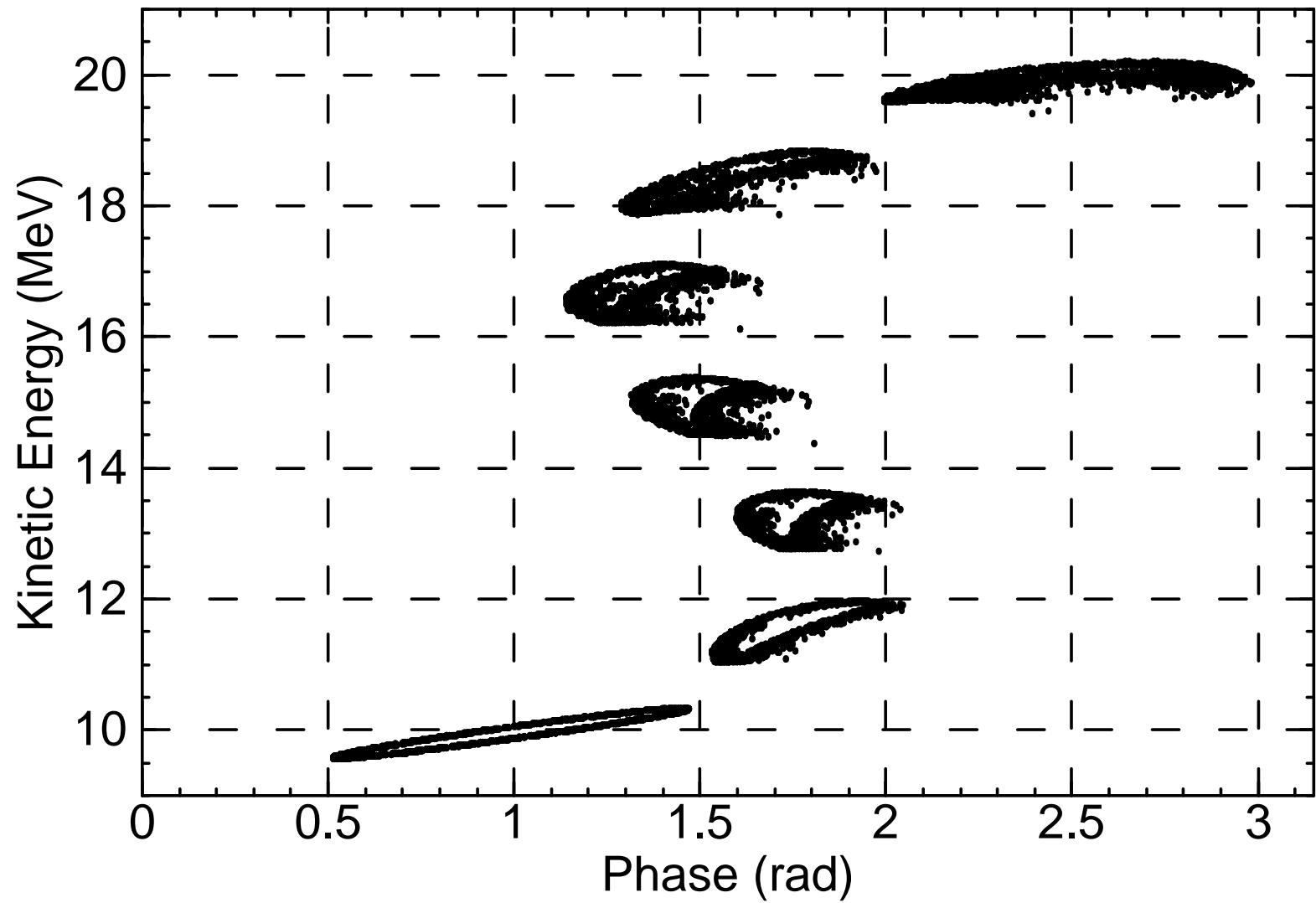
Different Transverse Amplitudes



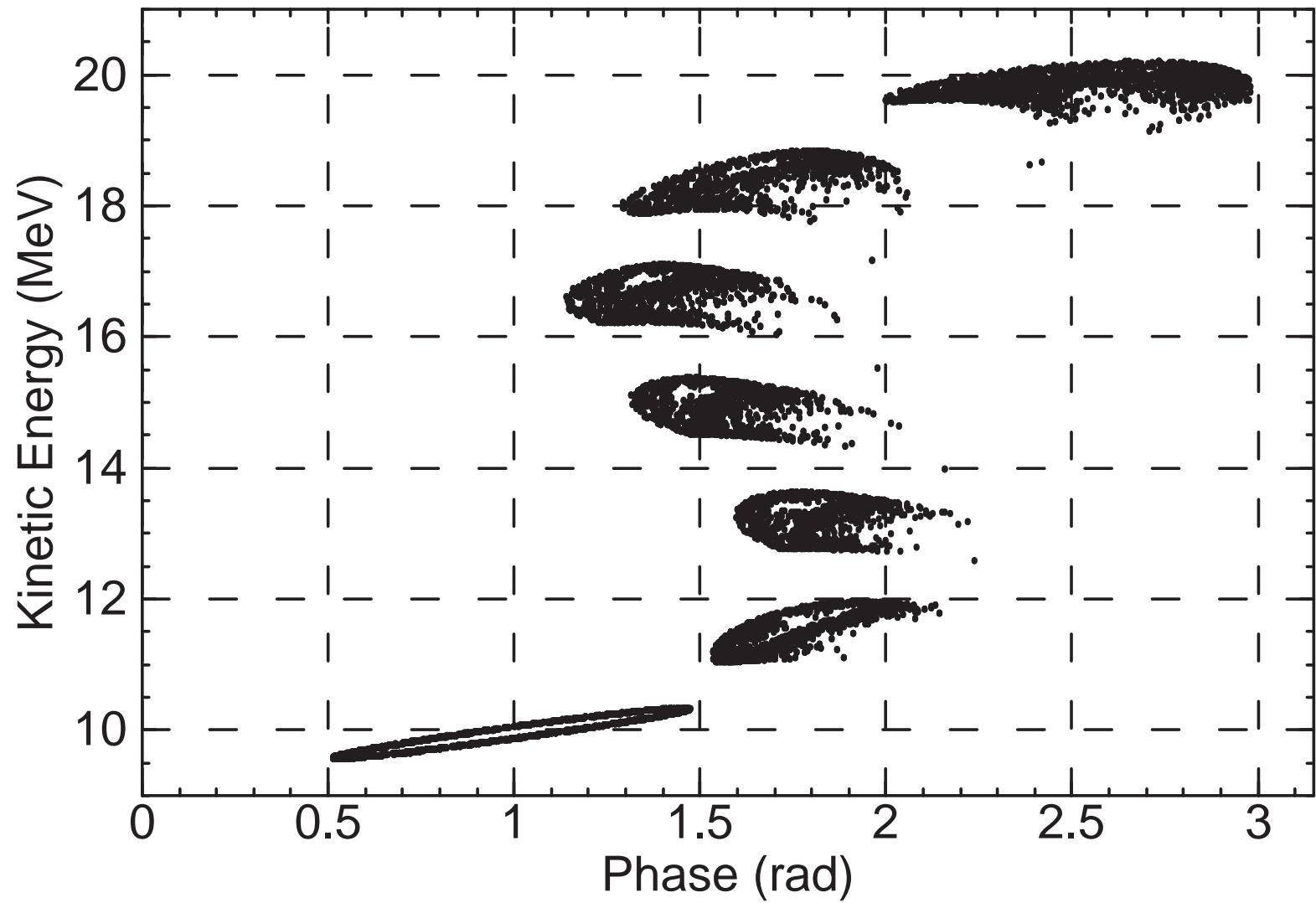
EMMA, Longitudinal Phase Space Zero Transverse Amplitude



EMMA, Longitudinal Phase Space Non-Zero Transverse Amplitude



EMMA, Longitudinal Phase Space Larger Transverse Amplitude



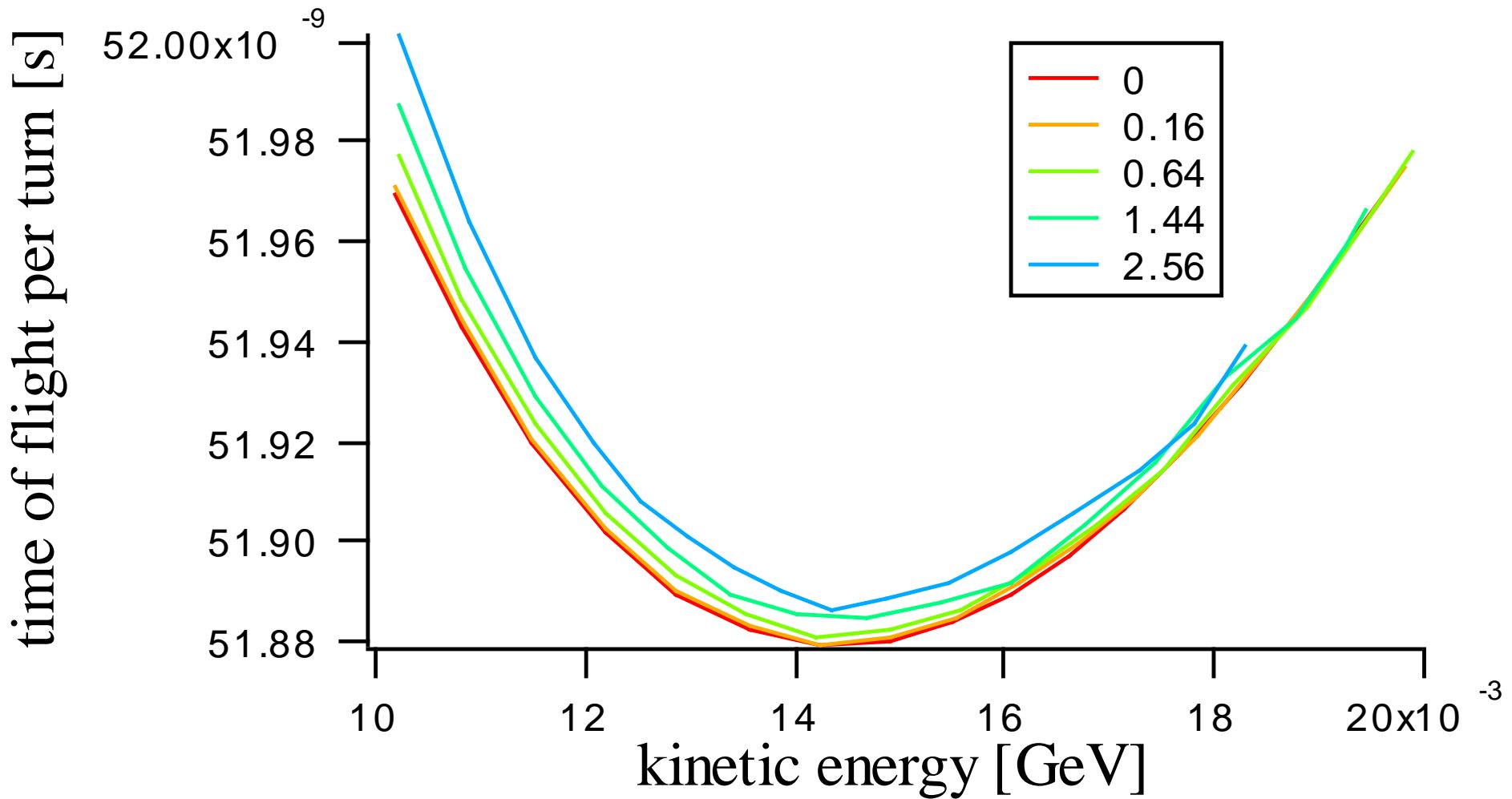
Cause: Variation of Time of Flight with Transverse Amplitude

- Time of flight vs. energy depends on transverse amplitude
- There is a relationship between time of flight variation with transverse amp and tune variation with energy:

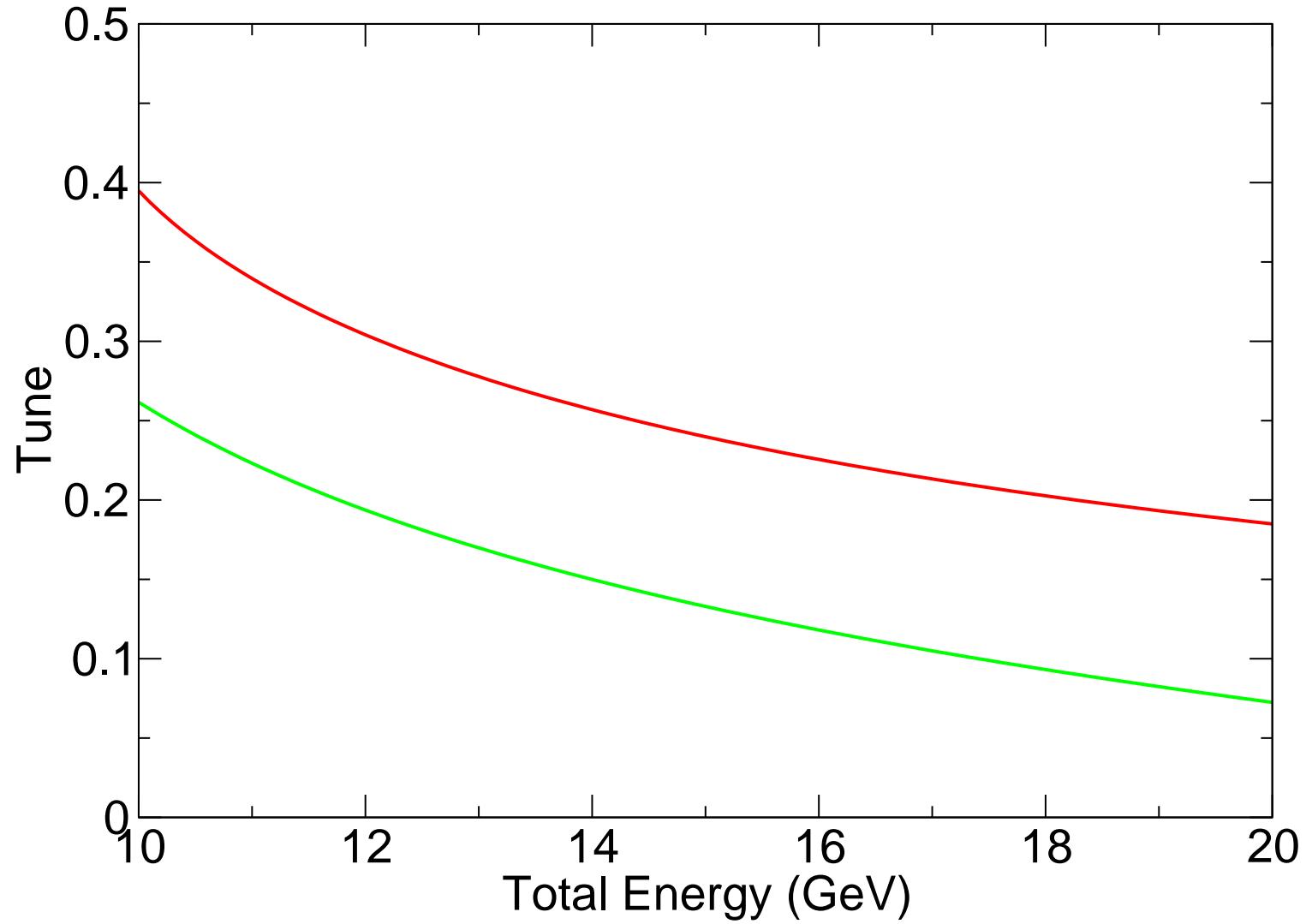
$$\frac{dT}{dJ} = -2\pi p \frac{d\nu}{dE}$$

- Significant tune variation with energy in non-scaling FFAGs, especially at low energy
- Can reduce tune variation with energy by reducing low-energy tune
 - ◆ Cost is larger RF voltage requirement

Time of Flight Variation with Transverse Amplitude



Tune Variation with Energy



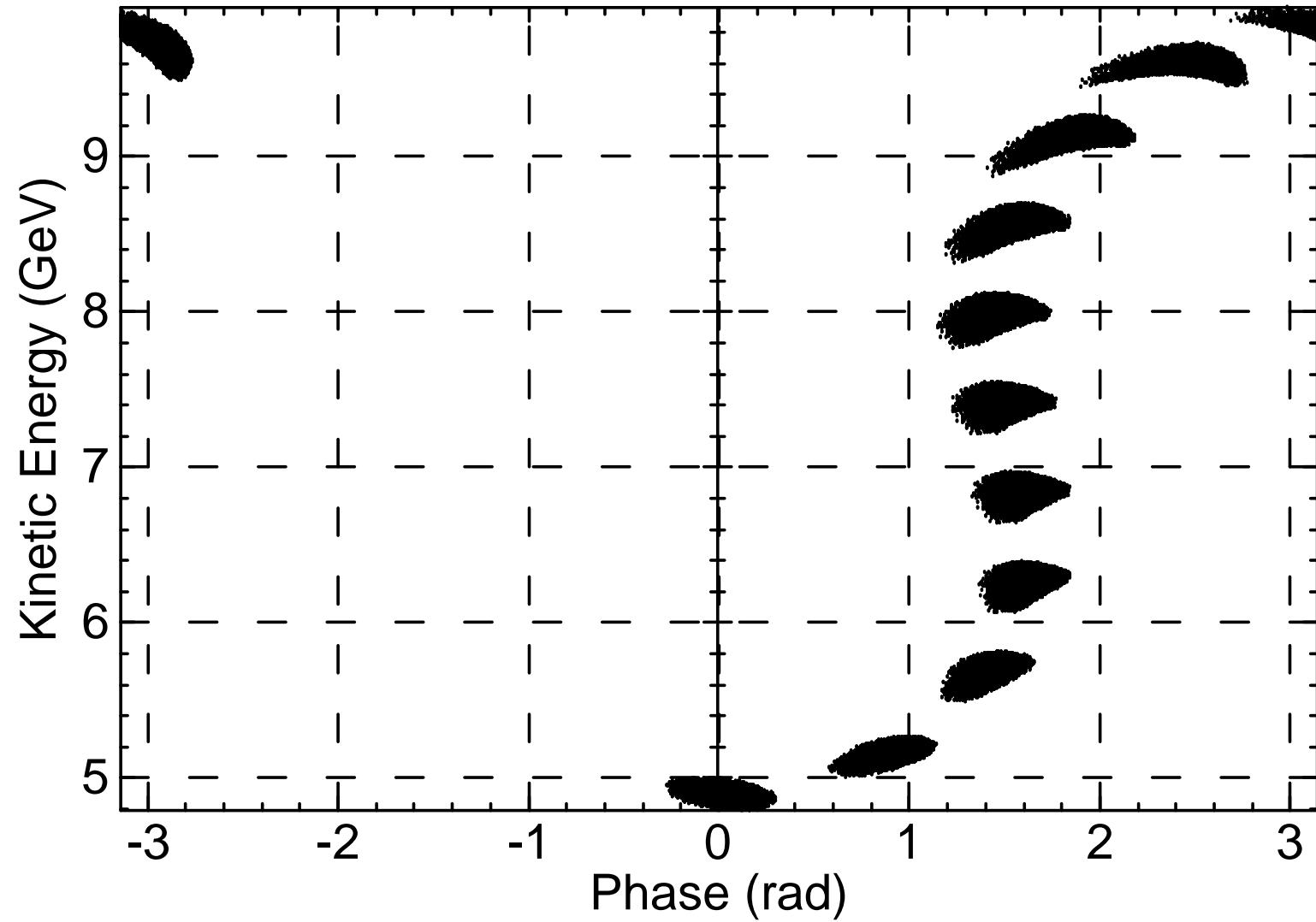
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Tracking Results on Muon FFAG

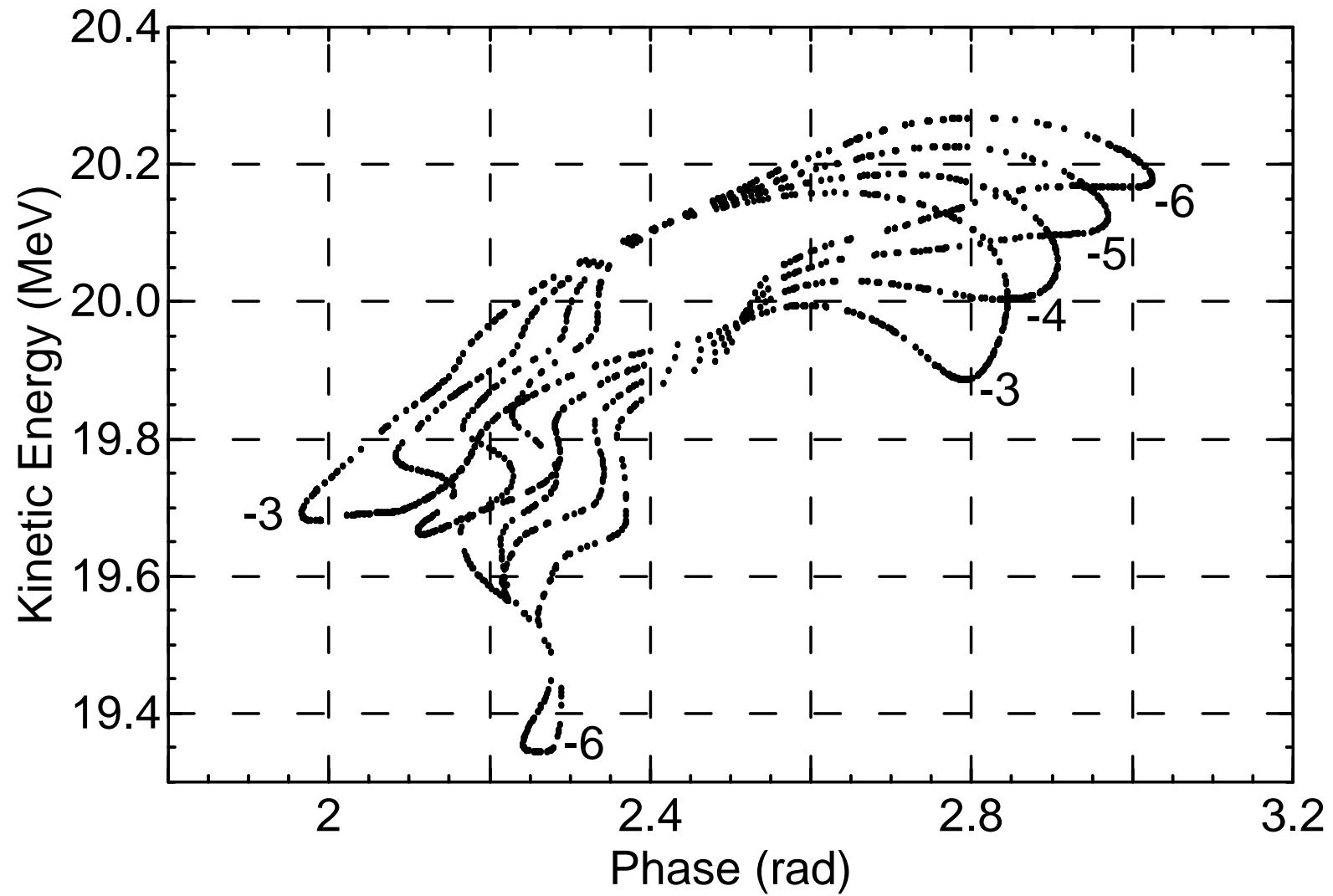
- See how bad things are for the Muon FFAGs
- Even at design, things don't look too bad
 - ◆ Ellipse orientation and aspect ratio that minimizes longitudinal distortion
 - ◆ Chose "b" parameter (zero on time-of-flight parabola) to get maximum longitudinanal phase space transmission
 - ★ May not be optimal from decay point of view
- Smaller amplitude gives small improvement
- Reduced low-energy tune also gives improvement
- Still need to quantify these results

Muon FFAG, Longitudianl Phase Space

30 mm Transverse Amplitude

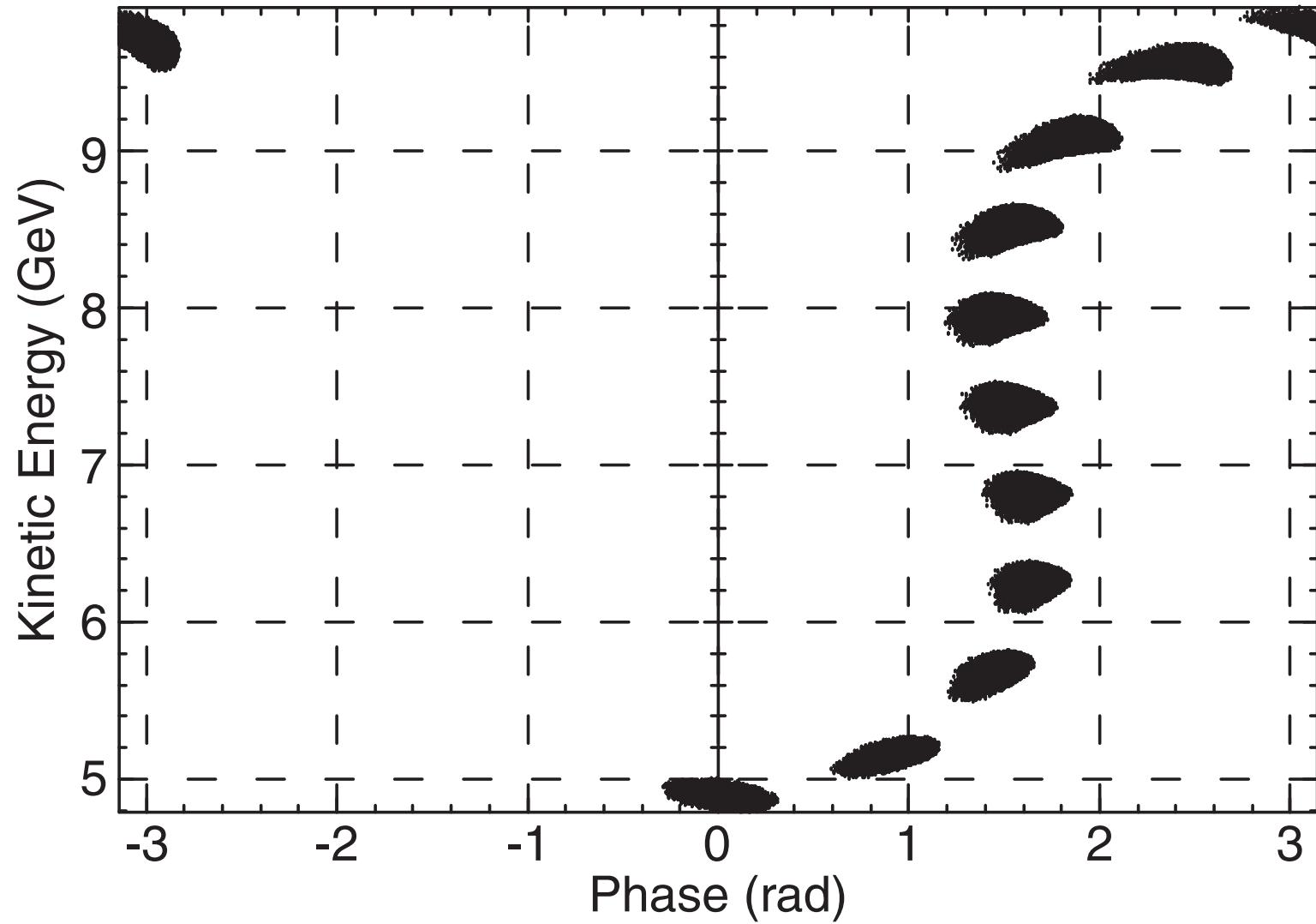


EMMA, Final Longitudinal Phase Space Vary Initial Ellipse Orientation



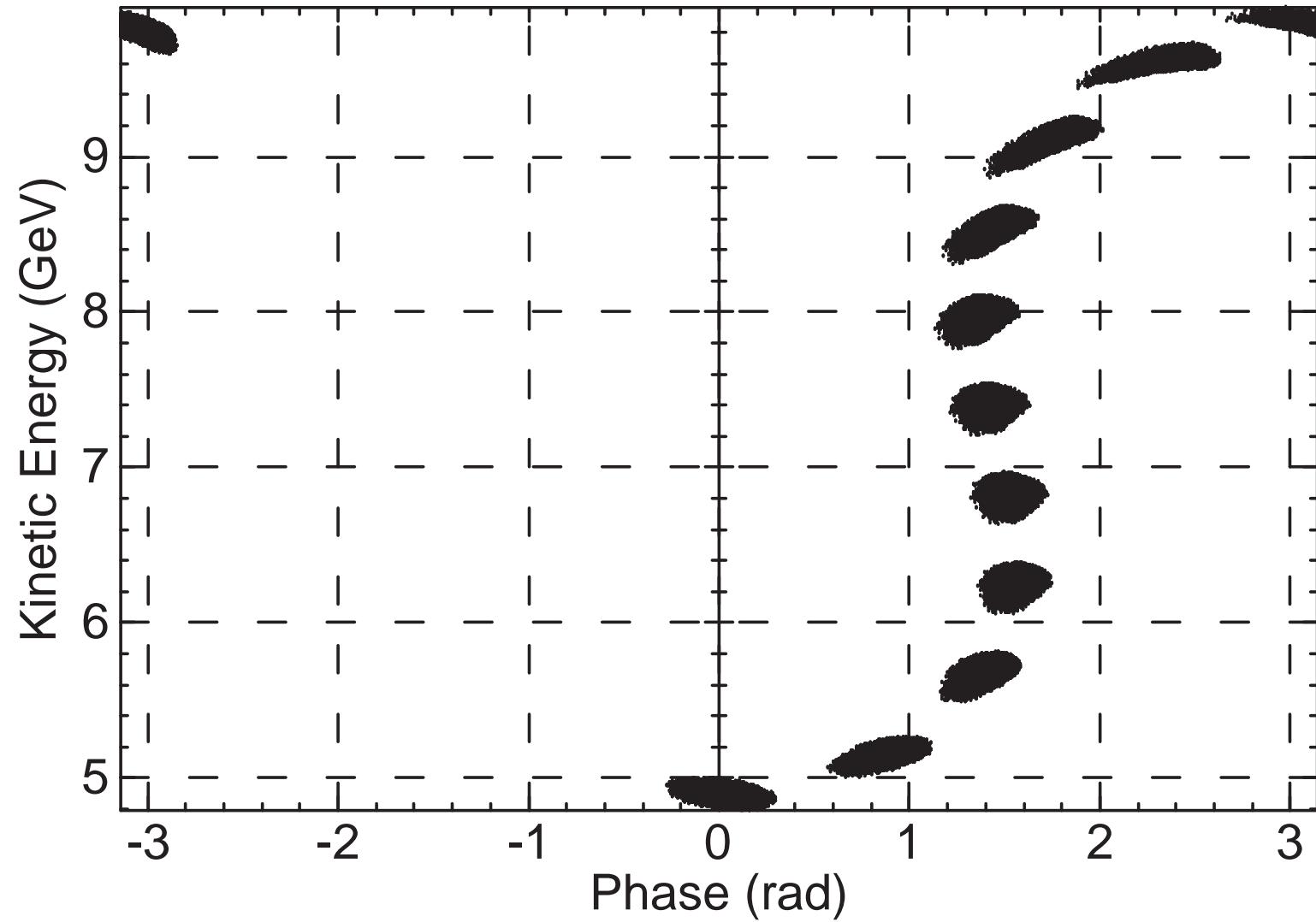
Muon FFAG, Longitudinal Phase Space

15 mm Transverse Amplitude



Muon FFAG, Longitudinal Phase Space

30 mm Transverse Amplitude, Lower Tune



To Do Next

- Next step in tracking: look at sensitivity to errors
- Try to understand how best to handle effect of transverse amplitude on longitudinal phase space
 - ◆ Good news, it seems to be manageable